Celunol Corporation

An Introduction

Presentation to: Massachusetts Cellulosic Ethanol Workshop
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John B. Howe, VP Public Affairs
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Celunol Corporation

Celunol is a technology driven company leveraging its proprietary biotechnology processes and project development know-how to lead the race to commercialize the production of cellulosic ethanol.

Our goal is to become a major producer of competitive, secure, and environmentally sound ethanol from an array of biomass sources.

Celunol: Company Overview

- **Privately held, founded 1994 as BC International**
- **Exclusive licensee of key cellulosic ethanol (CEtOH) technology developed at the University of Florida**
- **Major shareholders include:**
  - **Braemar Energy Ventures**
  - **Charles River Ventures**
  - **Khosla Ventures**
  - **Rho Capital Partners**

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Celunol: Company Operations

- **Headquarters: Cambridge, MA**
- **R&D facilities in Gainesville, FL**
- **Operating plant in Jennings, LA**
  - **Pilot facility (1st CEtOH in US) operational Nov.'06**
  - **Demonstration-scale CEtOH facility entering construction in 2007**
- **CEtOH facility in Osaka, Japan (wood waste) developed by Celunol licensee Marubeni Corp.**

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Ethanol: A Growing Market Opportunity

- **Current US market is 4B gallons/year, growing rapidly with new capacity coming on line**
- **EPAct 2005 Renewable Fuels Standard mandates use of ethanol grow to 7.5B gallons/year by 2012**
- **USDOE "30 by 30" strategy seeks to replace 30% of current motor fuel with renewable fuel by 2030 (implies US market of ±60 billion gallons)**
- **Global ethanol markets are also growing rapidly**

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Today's Ethanol Industry

- **Nearly all U.S. ethanol is produced from corn**
- **Outside the U.S., ethanol is made from sugarcane (most notably in Brazil)**
- **Production typically located near feedstock sources**
- **Ethanol retail distribution is rapidly growing in U.S. with spread of E10 and E85 blends**
- **Increase in E85-capable flexible fuel vehicles is also driving ethanol demand**
- **However, corn availability, prices and transport issues all limit the potential of grain-based ethanol production**

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The CEtOH Opportunity

- **Corn-based ethanol has set the stage for CEtOH**
- **CEtOH can be produced from a wide array of low-cost, abundant feedstocks, e.g.,**
  - **Sugar cane bagasse**
  - **Corn stover**
  - **Rice and wheat straws**
  - **Wood waste**
  - **Energy crops, etc.**
- **CEtOH feedstocks are typically not in competition with other uses – prices expected to be more stable**
- **CEtOH locations are not limited to the corn belt – can be sited closer to premium markets**

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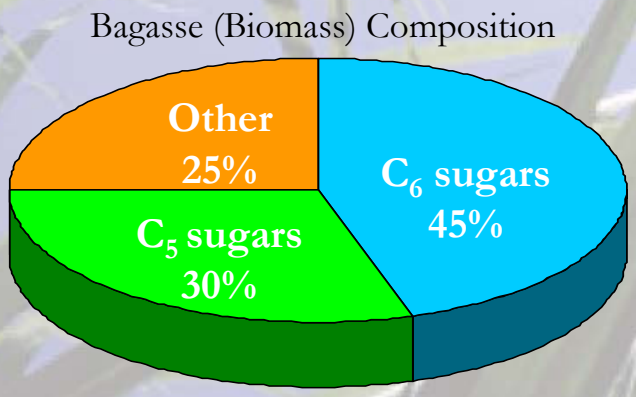
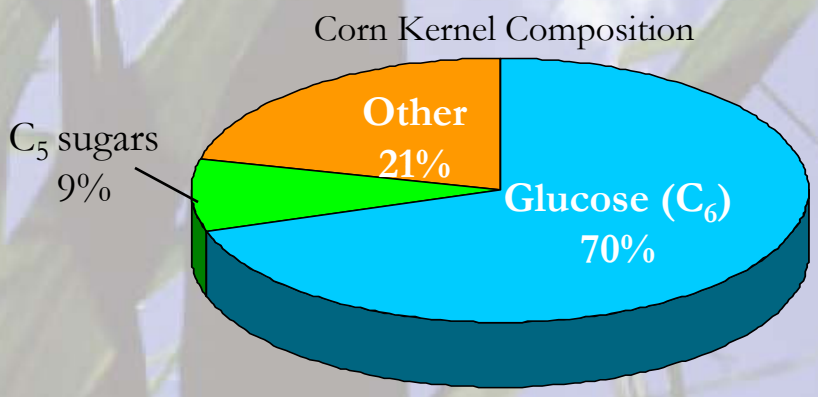
The CEtOH Challenge: Full Sugar Utilization

- **Corn starch is primarily glucose, a six-carbon sugar—fermentable by yeast**
- **Biomass has many non-glucose, five-carbon sugars—<u>not</u> commercially fermentable by yeast**





Fermenting both C_5 and C_6 sugars drastically improves the ethanol yield of biomass

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Celunol's Solution

- **Others have tried to modify yeast to ferment five-carbon sugars (some success, one sugar at a time)**
- **Celunol's organism consumes many sugars and was modified to produce ethanol**
  - **Developed by Prof. Lonnie Ingram, Univ. of Florida**
  - **Granted landmark U.S. patent no. 5,000,000**
  - **15 U.S. patents issued, 8 applications pending**
  - **46 Foreign patents issued, 56 applications pending**

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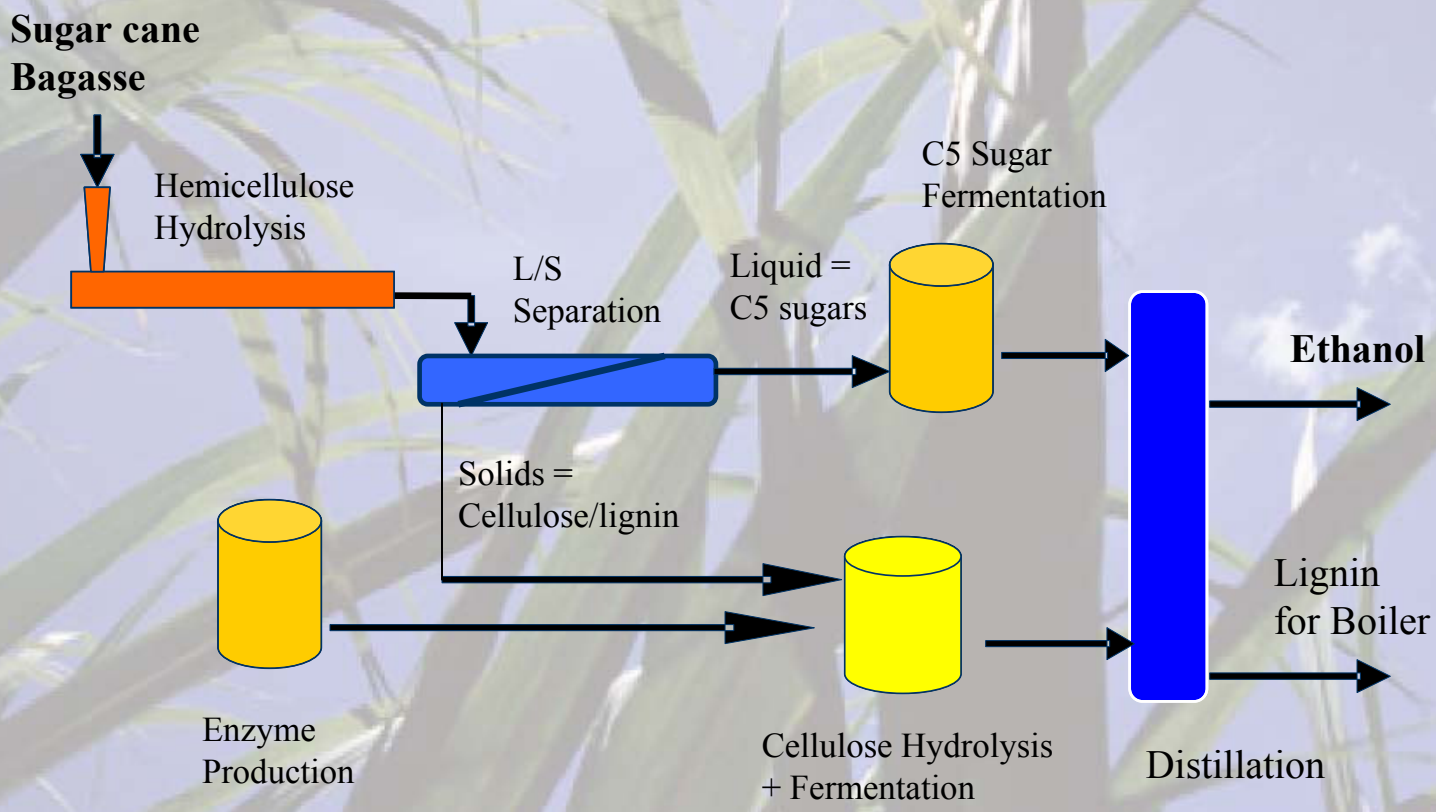
Celunol Technology Overview (1)

Two-Stage Process: Acid + Enzymes



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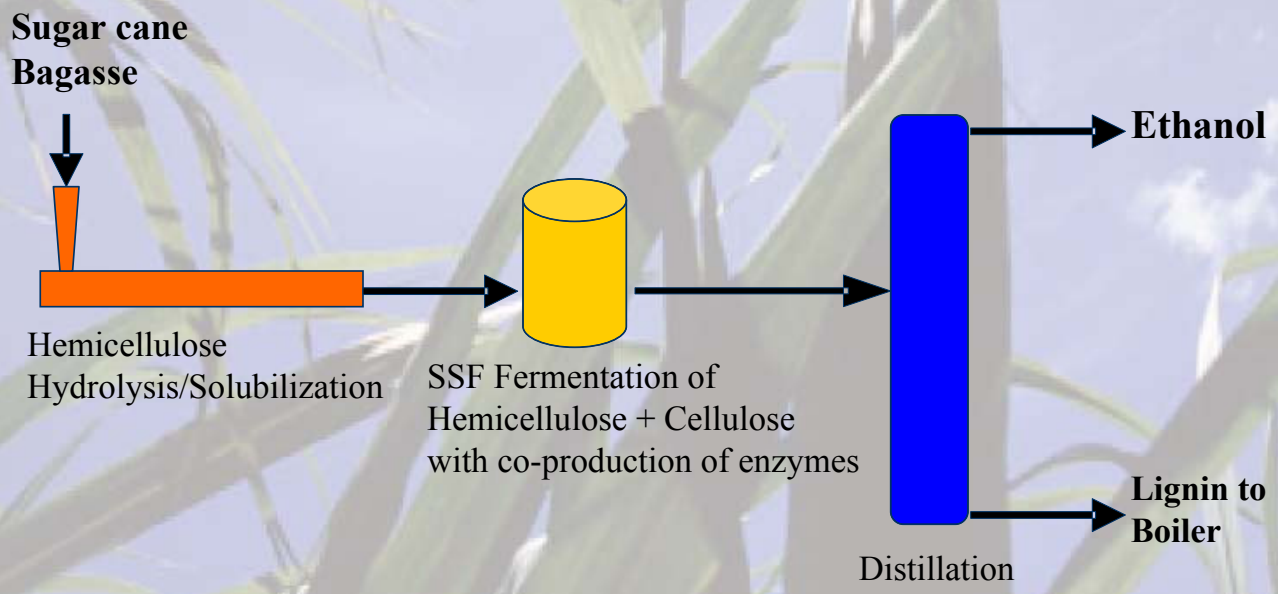
Celunol Technology Overview (2)

Future Process: One Fermentation



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Projected CEtOH Economics

- **Total cost per gallon for CEtOH production, when commercially mature, is expected to be highly competitive with conventional grain-based ethanol**
- **Additional advantage: CEtOH has large, as-yet untapped opportunities for further process improvement!**

	25M gal/yr Cellulosic	100M gal/yr Corn
• Feedstock cost	10 – 20 %	60 %
• Energy cost	0 – 20 %	20 %
• Variable costs	40 – 50 %	10 %
• Capital cost	20 – 30 %	10 %

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Path to Commercializing CE Technology

- **Pilot plant – 50,000 gallons/year**
  - **Upgrade completion** **Autumn 2006**
  - **Semi continuous operation to demonstrate pentose fermentation and enzyme-based cellulose fermentation**
- **Demonstration plant – 1.4 M gallons/year**
  - **Major equipment ordered** **Summer 2006**
  - **Completion of construction** **Spring 2007**
  - **Continuous operation to validate commercial design**
- **Commercial plant – 20 to 30 M gallons/year**
  - **Siting and permitting for first plant** **late 2006/2007**
  - **Preliminary design** **late 2007**
  - **Financing** **by early 2008**
  - **Operational** **late 2008/2009**

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Celunol Jennings, LA

Location

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Celunol Jennings, LA

Former Conventional Ethanol Production Site

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Celunol Pilot Plant

Feedstock Handling

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Celunol Pilot Plant

Hydrolysis

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Celunol Pilot Plant

Fermentation

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Marubeni Pilot Plant (Osaka, Japan)

- **First wood waste demonstration plant under construction in Osaka, Japan**
- **Completed autumn 2006**
- **Celunol has licensed its technology to Marubeni Corporation on a non-exclusive basis**

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Celunol's Strategy for Growth

- **Continue to develop and expand the company's patented, proprietary biomass CEtOH technology**
- **Develop, own, operate major ethanol facilities using either 100% biomass or grain + biomass**
- **Joint venture with grain ethanol producers to add CEtOH technology to existing production**
- **License technology domestically and internationally**
- **Seek additional funding in 2007 to support continued CEtOH technology development and equity commitments for new projects**

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Conclusion

Q: Economical fuels from Biomass: Are we there yet?

- **The science of CEtOH is now well-established**
- **The ethanol commodities market is now well-developed**
- **US and state government policies now in place provide strong support for the first CEtOH demonstration plants**
- **Finance and project development skills from other industries are now being brought to bear in a disciplined, staged approach to project design and contracting**

A: YES!

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Thank You! Questions?

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